REMARKS

Claims 1-26 are pending in the subject application. Claims 1, 9, 17 and 26 have been amended. Claims 27-33 have been added. The amendments to claims 1, 9, 17 and 26 and added claims 27-33 is supported by the specification as filed, and no new matter is presented. Favorable reconsideration in light of the remarks which follow is respectfully requested.

1. <u>35 U.S.C. §102/103 Rejections</u>

McCullough

Claims 1-26 have been rejected under 35 U.S.C. §102(e) as anticipated by or, in the alternative, under 35 U.S.C.§103(a) as obvious over McCullough, U.S. 6,555,486. The Office asserts:

> This patent shows thermally conductive polymeric material compositions which have incorporated therein thermoplastic polymers, solvents and a thermally conductive filler material. See specifically column 4 lines 19+. This portion of the patent shows the relative percentages including the higher percent as requisite claims 4-6. The Examiner maintains that this portion of the patent teaches each of applicants' claimed limitations and as such the claims are anticipated.
>
> It is acknowledged however that this patent does not provide an example. Should one determine that this is not an anticipatory reference, then it is nonetheless highly relevant as seen to render obvious the instantly claimed invention. There is very little selection of ingredients necessary so as to arrive at applicants' instantly claimed composition and as such one of ordinary skill in the art would in fact be motivated so as to select the ingredients as well as the relative percentages so as to formulate a composition which renders obvious applicants' instantly claimed invention.

Applicants respectfully traverse.

Polymeric materials are generally made thermally conductive by incorporating thermally conductive filler materials into a base polymeric material. In the case of thermally conductive fibers, the length and orientation of the fibers impacts the thermal conductivity of the polymeric material. In general, higher concentrations of the filler material, greater lengths of the fibers and orientation of the fibers parallel to the heat flow will increase thermal conductivity of the base polymeric material to which the filler material is added. However, incorporation if high concentrations of

fillers negatively impacts the downstream processing of the polymeric materials. Further, as higher concentrations of the filler material are added, other important properties of the base polymeric material often deteriorate (e.g. weakening of the polymeric material and, as a result, thermally conductive polymeric materials that are too brittle for their intended use. Still further, current methods for incorporating thermally conductive fibers into polymeric materials are not capable of adequately maintaining the lengths of the fibers. Thus, to date, the concentration of filler material that can be added to a base polymeric material and the lengths of the fibers after incorporation have been limited.

Claim 1

Applicants teach methods for making the thermally conductive polymeric materials wherein high levels of thermally conductive filler can be loaded in a polymeric material. In particular, Applicants' teach thermally conductive fillers dispersed in molding powders for subsequent formation into molded objects. Applicants further teach methods that minimize fiber breakage and maintain fiber orientation when the filler material is a fibrous filler material.

In particular, Applicants claim, in claim 1, a composition for forming a thermally conductive polymeric material, comprising: a least one thermoplastic polymeric material, a thermally conductive filler material and at least one solvent in which the at least one thermoplastic polymeric material is at least partially soluble. As set out, the thermally conductive filler material added to the composition is a carbon fiber having a first length and wherein the first length is substantially the same as the length of the carbon fiber in the formed thermally conductive polymeric material. In other words, Applicants teach a composition wherein the carbon fiber added to the composition has a first length and wherein the composition forms a thermally conductive polymeric material containing carbon fibers having a length substantially equal to the first length. In other words, during formation of the thermally conductive polymeric materials, the carbon fibers substantially maintain their lengths, which, to date, has not been achieved with prior methods or compositions. In particular, prior methods and compositions caused breakage of the

carbon fibers along their lengths, which negatively impacts the thermal conductivity of the resultant material.

The McCullough reference, on the other hand, describes thermally conductive elastomeric coatings for use in connection with heat generating electronic devices, particularly computer chips. According to McCullough, the coatings contain a thermally conductive filler. (See col. 4, lines 15-18) According to McCullough, the thermally conductive filler is preferably particles of boron nitride, but can also be alumina nitride and alumina as well as carbon materials such as carbon fiber. (See col. 5, lines 7-11).

However, there is no description or suggestion of a composition wherein the thermally conductive filler is a fiber having a first length and wherein the material formed from the composition contains thermally conductive fibers having lengths substantially equal to the first length.

As provided in MPEP-2131, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Or stated another way, "The identical invention must be shown in as complete detail as is contained in the ... claims. *Richardson v Suziki Motor Co.*, 868 F.2d 1226, 9 USPQ 2d. 1913, 1920 (Fed. Cir. 1989). Although identify of terminology is not required, the elements must be arranged as required by the claim. *In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990).

As clearly set out above, McCullough does not teach each and every element of Applicants' claim 1. In particular, McCullough does <u>not</u> teach a composition for forming a thermally conductive polymeric material wherein the carbon fiber added to the composition has a first length and wherein the composition forms a thermally conductive polymeric material containing carbon fibers having a length substantially equal to the first length.

Further, this property would not be inherent in McCullough. It is well established that "To establish inherency, the extrinsic evidence 'must make clear that the **missing descriptive matter is necessarily present** in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. **Inherency, however, may not be established by probabilities or possibilities**. The mere fact that a certain thing **may result** from a given set of circumstances **is not sufficient**.' " *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) MPEP § 2112

As set out, when forming thermally conductive polymeric materials by addition of thermally conductive fibers, the thermally conductive fibers are sensitive to sheer and prone to breakage. Thus, it is difficult to maintain their lengths. Applicants teach methods and compositions wherein it is possible to maintain fiber length. Unless a composition for forming thermally conductive polymeric materials and methods for use are specifically designed so as to maintain fiber length, the fiber length will not be maintained. Further, attempts at maintaining fiber length to date have been inadequate. McCullough does not describe or suggest maintaining fiber length, how to do so, or even whether it is possible. The compositions of McCullough would not necessarily maintain fiber length when formed into materials. At best, this may only possibly occur. Thus, this is not inherent in McCullough.

Thus, claim 1 is not anticipated by McCullough. Claims 3-8 and 27-33 depend from claim 1 and, likewise, are not anticipated by McCullough.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). MPEP 2142.

As set out above, McCullough does not teach or suggest all of Applicants' claim limitations. Further, there is no suggestion or motivation to modify the McCullough reference. Rather, this suggestion comes purely from Applicants' disclosure. Applicants note that while it may be desirable to maintain fiber length, there is no teaching or suggestion of whether this can be done and, if so, how this can be done. Thus, even if an outcome is desirable, if there is no teaching of how to attain the outcome and the outcome has not yet been attainable, then it is not obvious.

Thus, claim 1 is not obvious over McCullough. Claims 3-8 and 27-33 depend from claim 1 and, likewise, are not obvious over McCullough.

Claim 9

Applicants claim, in claim 9, a thermally conductive polymeric material, comprising at least one polymeric material and at least 55 wt% of a thermally conductive filler material.

McCullough describes thermally conductive elastomeric coatings for use in connection with heat generating electronic devices, particularly computer chips. Applicants respectfully submit that McCullough does not teach a material comprising at least 55 wt% (claim 9), or at least 60 wt% (claim 15) or at least 70 wt% (claim 16) of a thermally conductive filler material. McCullough sets out that:

> The thermally conductive material composition of the present invention comprises a visible light curable elastomeric material, a catalyst, a thermally conductive filler and a hydrocarbon solvent. In the preferred embodiment the visible light curable composition comprises by weight from about 35% to about 75% of a visible light curable elastomeric material, from about 0.5% to about 15% catalyst, from about 10% to about 30% hydrocarbon solvent and from about 20% to about 70% conductive filler. The amount of hydrocarbon solvent added is controlled by the required viscosity of the resultant material in order to facilitate screen or stencil printing while maintaining sufficient viscosity to stay in place on the substrate at the desired layer thickness without slump or sag prior to the curing operation. (Col. 4, lines 15-23)

However, based on this description, the composition could not possibly contain these combinations of materials in these ratios. According to McCullough, the following ranges are present:

visible light curable elastomeric material	35% - 75%
catalyst	0.5% - 15%
hydrocarbon solvent	10% - 30%
conductive filler	20% - 70%

Thus, if the composition was to contain 70% conductive filler, then the remainder of components, in combination would form the remainder 30%. However, according to McCullough, there is, at a minimum, 35% of visible light curable elastomeric material. Thus, the conductive filler could not be contained in this amount. The maximum amount of conductive filler would be present when the remainder of components are present at their minimal amounts. This would occur when there is 35% visible light curable elastomeric material, 0.5% catalyst, 10% of hydrocarbon solvent, for a total of 45.5%. The conductive filler would form the remainder of the composition – 54.5%. Thus, the maximum possible amount of conductive filler in the composition would be 54.5%.

Accordingly, Applicants respectfully submit that McCullough does <u>not</u> teach or suggest a polymeric material containing the amounts of conductive filler attained by Applicants. As set forth above, it is difficult to add large amounts of filler to materials without negatively impacting important properties of the materials and rendering the materials useless for their intended purpose. Applicants have found a method by which this is possible.

Thus, claim 9 is not anticipated or obvious over McCullough. Claims 10-16 depend from claim 9 and, likewise, are not obvious over McCullough.

<u>Claim 17</u>

Applicants claim, in claim 17, a method for forming a thermally conductive polymeric material, the method comprising forming a solution by at least partially dissolving a thermoplastic polymeric material in a solvent, adding a thermally

conductive filler material to the solution, and removing the solvent from the solution. According to Applicants' method, the thermally conductive filler is a fiber and the length of the fiber in the thermally conductive polymeric material is substantially the same as the length of the fiber prior to addition to the solution. In other words, the fiber length is substantially maintained during Applicants' method.

As set out above, McCullough describes thermally conductive elastomeric coatings for use in connection with heat generating electronic devices, particularly computer chips. The coatings of McCullough contain a thermally conductive filler that is preferably boron nitride particles, but can also be alumina nitride and alumina as well as carbon materials such as carbon fiber. However, there is absolutely <u>no</u> description or suggestion of a material or method for formation of a material having thermally conductive fibers incorporated therein such that the length of the fibers after incorporation is substantially the same as the length of the fibers prior to incorporation. Rather, McCullough merely suggests that the fillers can be fibers and does not mention fiber length, whether fiber length can be maintained, or if so how.

Thus, claim 17 is not anticipated or obvious over McCullough. Claims 18-24 depend from claim 17 and, likewise, are not anticipated or obvious over McCullough.

<u>Claim 25</u>

Applicants claim, in claim 25, a solvent blending method for forming a thermally conductive polymeric material by blending a thermally conductive fibrous filler with a polymeric material, wherein the length of the thermally conductive fibrous filler after blending is substantially the same as the length of the thermally conductive fibrous filler after forming the thermally conductive polymeric material.

As set out above, McCullough does not teach a method for forming a thermally conductive polymeric material by blending a thermally conductive fibrous filler with a polymeric material, wherein the length of the thermally conductive fibrous filler after blending is substantially the same as the length of the thermally conductive fibrous filler after forming the thermally conductive polymeric material. McCullough merely describes a method wherein a thermally conductive filler is incorporated into a

coating. These fillers can include fibers. However, there is absolutely no description or suggestion of a material or method for formation of a material having thermally conductive fibers incorporated therein such that the length of the fibers after incorporation is substantially the same as the length of the fibers prior to incorporation. Rather, McCullough merely suggests that the fillers can be fibers and does not mention fiber length, whether fiber length can be maintained, or if so how.

Further, maintenance of fiber length would not be inherent in McCullough. When forming thermally conductive polymeric materials by addition of thermally conductive fibers, the thermally conductive fibers are sensitive to sheer and prone to breakage. Thus, it is difficult to maintain their lengths. Applicants teach methods and compositions wherein it is possible to maintain fiber length. McCullough does not describe or suggest maintaining fiber length, how to do so, or even whether it is possible. The compositions of McCullough would not necessarily maintain fiber length when formed into materials. At best, this may only possibly occur. Thus, this is not inherent in McCullough.

Thus, claim 25 is not anticipated or obvious over McCullough.

Claim 26

Applicants claim, in claim 26, a method for minimizing fiber breakage when forming a thermally conductive polymeric material comprising forming a solution by at least partially dissolving a polymeric material in a solvent, adding a thermally conductive filler material to the solution, the thermally conductive filler material comprising fibers and removing the solvent from the solution, wherein breakage of the fibers is minimized.

As set out above, McCullough does not teach or suggest a method for forming a thermally conductive polymeric material by adding thermally conductive fibers to a polymeric material wherein breakage of the fibers is minimized. McCullough does not mention or suggest the fiber length or that breakage along the fiber length can be minimized. Further, fibers are sensitive to sheer and are prone to breakage. Thus, minimization of breakage along the fibers' length would not be inherent because

breakage along the fiber length is likely and minimization of breakage would not necessarily result from McCullough.

Thus, claim 26 is not anticipated or obvious over McCullough.

Cole et al or Afzali-Ardakani et al

Claims 1-26 have been rejected under 35 U.S.C §103(a) as being unpatentable over Cole et al., U.S. Patent 5,230,956 or Afzali-Ardakani et al., U.S. Patent 5,559,611. The Office asserts:

> Cole shows thermoplastic polymers used as sizing agents for carbon fiber composites. Applicants' instantly claimed solvents are clearly shown at column 5 lines 61+. It is maintained that each of applicants' claim limitations is suggested within this patent and as such it would be prima facie obvious to one of ordinary skill in the art to arrive at the claimed composition
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> The Afzali-Ardakani patent also shows thermoplastic polymers which are therein mixed with a solvent as claimed. See column 7 lines 35+. The instantly claimed fillers are shown at column 11 lines 10+ and the specifically claimed carbon filler is the subject of claim 15 in this patent. It is acknowledged that the enabling disclosure does not show a clear example of each of applicants' instantly claimed ingredients being used in combination falling within the amounts as claimed. However each is suggested to be utilized in combination with one another and such a suggestion is sufficient to provide the sufficient motivation for one of ordinary skill in the art so as to combine the ingredients in the manner as claimed. As such, applicants' instantly claimed invention is rendered prima facie obvious.

Applicants respectfully traverse.

Afzali-Ardakani describes a curable cyanate (thermoset resin) having improved toughness as a result of the incorporation of reactive thermoplastic oligomers.

Cole describes fibers which are coated or sized on the surface in order to be used specifically as polyamide-imide sized carbon fibers with a maximum of 5% of polyamide-imide.

Applicants, on the other hand, teach thermally conductive polymeric materials and methods for manufacture wherein the thermally conductive polymeric materials

are loaded with at least one thermally conductive filler. The filler is a fiber and is incorporated so as to minimize breakage of the fiber along its length. As such, the length of the fiber after incorporation is substantially the same as prior to incorporation. Still further, Applicants materials and methods for formation are capable of loading high concentrations of filler into the polymeric materials that have not previously been successfully attainable. In particular, Applicants incorporate highly graphic fibers into polymeric materials by solution. Applicants' thus formed thermally conductive polymeric materials provide polymeric materials with improved thermal conductivity that can be subsequently molded into parts.

Applicants respectfully submit that Afzali-Ardakani and/or Cole, along and in combination, do <u>not</u> teach or suggest all of Applicants' claim limitations.

In particular, neither Afzali-Ardakani nor Cole teach or suggest a method or composition for forming a thermally conductive polymeric material comprising thermoplastic polymeric material(s), a thermally conductive filler material and at least one solvent wherein the thermally conductive filler material is a carbon fiber and the length of the carbon fiber in the formed thermally conductive polymeric material is substantially the same as the length of the carbon fiber prior to adding the carbon fiber to the composition (claims 1, 17, 25) or wherein breakage of the fibers is minimized (claim 26). Afzali-Ardakani merely describes incorporating fillers into a curable material. Afzali-Ardakani does not teach or suggest that the filler is a fiber, that the length of the fiber can be maintained during incorporation such that the length of the fiber after incorporation is substantially the same as the length of the fiber prior to incorporation or, if the length of the fiber can be maintained, how. Cole merely describes coating reinforcing fibers <u>onto a surface of a composite</u>. Cole does not teach or suggest <u>loading</u> of a thermally conductive fiber <u>into a polymeric material</u> or how, during such loading, the length of the fibers is maintained.

Further, neither Afzali-Ardakani nor Cole teach or suggest adding at least 55 wt% of a thermally conductive filler material to a polymeric material to form a thermally conductive polymeric material (claim 9). As set out above, it is difficult to add large quantities of thermally conductive filler to polymeric materials and, thus, to

date the concentration of filler material that can be added to a base polymeric material has been limited. Afzali-Ardakani does not teach or suggest any particular amount of thermally conductive fiber. Further, Cole does not incorporate thermally conductive filler material into a polymeric material. Rather, Cole merely coats a composite with reinforcing fibers.

Still further, neither Afzali-Ardakani nor Cole teach or suggest a method for minimizing fiber breakage when forming a thermally conductive polymeric material (claim 26). Rather, Afzali-Ardakani merely describes incorporating fillers into a curable material. The use of fibers having a particular length or the minimization of breakage along to fiber length is not taught or even suggested by Afzali-Ardakani. Cole merely coats fibers onto the surface of a composite. The use of fibers having a particular length or the minimization of breakage along to fiber length is not taught or even suggested by Cole. In sum, neither Afzali-Ardakani and Cole teach or suggest that fiber breakage can be minimized during incorporation into a polymeric material or, if so, how.

Thus, claims 1, 9, 17, 25 and 26 are patentable over Afzali-Ardakani and/or Cole. Claims 2-8, 10-16, 18-24 and 27-33 depend from claims 1, 9, 17, 25 and 26 and, likewise are patentable over Afzali-Ardakani and/or Cole.

2. <u>35 U.S.C. §112 Rejections</u>

Claim 9 has been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. The Office asserts that "This claim appears to have a typographical error wherein there is no period and it appears that there is a missing ingredient."

Applicants have amended claim 9 as required. Reconsideration and withdrawal of the rejection is respectfully requested.

CONCLUSION

Reconsideration and allowance of claims 1-33 is respectfully requested in view of the foregoing discussion. Further, withdrawal of the restriction requirement is respectfully requested in view of the forgoing discussion. This case is believed to be in

Applicants conditionally petition for an extension of time to provide for the possibility that such a petition has been inadvertently overlooked and is required. As provided below charge Deposit Account No. **04-1105** for any required fee.

Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned attorney would appreciate the opportunity to do so.

Respectfully submitted,

Lisa Swiszcz Hazzard (Reg. No. 44,368)
EDWARDS & ANGELL, LLP
P.O. Box 9169
Boston, MA 02209
Tel. No. (617) 517-5512